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## Phase structure of large- $N$ gauge theory at finite temperature

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We use a semiclassical method to analyze the phase structure of  $SU(N)$  gauge theory at infinite  $N$  in the presence of the external field. The effective potential can be written in terms of a Landau free energy for Polyakov loops, and we construct it using the perturbative contribution and a double trace deformation as the unknown confining potential. We show that there is a surface of a continuous phase transition analogous to the Gross-Witten-Wadia transition, whose boundary terminates at a tricritical point of a critical first-order phase transition. Depending on the confining potential we have considered, it gives rise to a third, fourth, or fifth-order phase transition in the Ehrenfest classification. Because the specific heat and the eigenvalue distribution of the Polyakov loop are sensitive to the confining potential, we argue that lattice simulations for large  $N$  could probe the order of phase transition as well as the form of the confining potential in any 1+d dimensions.

**Primary author:** NISHIMURA, Hiromichi (BNL)

**Co-authors:** Dr ROBERT, Pisarski (BNL); Dr SKOKOV, Vladimir (BNL)

**Presenter:** NISHIMURA, Hiromichi (BNL)